

Soil Mechanics

HW5

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Problem ①: (A) The maximum dry unit = 1.6222 g/cm

The optimum moisture content = 20%

(B) doesn't intersect the compaction curve

(C) I attach an Excel file contain all the figures

$$(d) e_{omc} = 0.6641$$

$$S_{omc} = 0.82$$

$$(e) DOC = \frac{\gamma_d(\text{field})}{\gamma_d(\text{max})}$$

$$\rightarrow \gamma_d(\text{field}) = 0.95 * 1.6222 = 1.54109 \text{ g/cm}$$

Problem (2): Given: * Calibration density of sand = 1667 Kg/m^3

$$\begin{aligned} * \text{ mass of sand needed to fill the cone} &= m_1 \\ &= 0.117 \text{ Kg} \end{aligned}$$

$$\begin{aligned} * \text{ mass of jar + cone + sand before use} &= m_2 \\ &= 6.1 \text{ Kg} \end{aligned}$$

$$\begin{aligned} * \text{ mass of jar + cone + sand after use} &= m_3 \\ &= 2.83 \text{ Kg} \end{aligned}$$

$$\begin{aligned} * \text{ mass of moist soil from the hole} &= m_4 \\ &= 3.35 \text{ Kg} \end{aligned}$$

$$* W = 16.1 \% = 0.161$$

* Volume of sand:

$$V = \frac{m_2 - m_3 - m_1}{\rho_{\text{sand}}} = 1.89 * 10^{-3} \text{ m}^3$$

* mass of dry soil:

$$m_d = \frac{m_4}{1+W} = 2.885 \text{ Kg}$$

$$\textcircled{A} \gamma_d: \gamma_{\text{dry}} = \frac{m_d \cdot g}{V_t} = \frac{2.885 * 9.81}{1.89 * 10^{-3}}$$

$$= 14.98 \text{ KN/m}^3$$

$$= 1.527 \text{ Kg/m}^3$$

$$\textcircled{B} \quad (\gamma_d)_{\max} = \frac{G_s \gamma_w}{1 + e_{\min}}$$

$$\begin{aligned} e_{\min} \text{ when } S=1: \quad e &= W G_s \\ &= 0.161 * 2.65 \\ &= 0.427 \end{aligned}$$

$$\begin{aligned} \rightarrow \gamma_d(\max) &= \frac{2.65 * 9.81}{1.427} \\ &= 18.218 \text{ kN/m}^3 = 1.857 \text{ Kg/m}^3 \end{aligned}$$

$$\begin{aligned} * \text{ Doc} &= \frac{1.527}{1.857} = 0.822 * 100\% \\ &= 82.2\% \end{aligned}$$

\textcircled{C} Doesn't met

$$\begin{aligned} \textcircled{d} * \gamma_d &= \frac{G_s \gamma_w}{1+e} \quad \rightarrow \quad 1+e = \frac{G_s \gamma_w}{\gamma_d} \\ e &= \frac{2.65 * 1}{1.527} - 1 \end{aligned}$$

$$\rightarrow e = 0.735$$

$$* S = \frac{2.65 * 0.161}{0.735} = 0.58 * 100\% = 58\%$$

Problem ③:- $e_{\text{embankment}} = \frac{V_T - V_s}{V_s}$

$$0.7 V_s + V_s = 7500$$

$$V_s = 4411.76 \text{ m}^3$$

	$e = \frac{V_T - V_s}{V_s}$	Cost
borrow pit ①	$V_T = 8161.756 \text{ m}^3$	89779.316 \$
borrow pit ②	$V_T = 8470.58 \text{ m}^3$	67764.64 \$
borrow pit ③	$V_T = 9749.990 \text{ m}^3$	87749.91 \$
borrow pit ④	$V_T = 8338.23 \text{ m}^3$	83382.3 \$

borrow pit ② → lower Cost

Problem (4):- (An Excel file attach with the Sol.)

The maximum dry unit = 17.38 kN/m^3

The optimum moisture content = 16.9%

* From the second Curve:

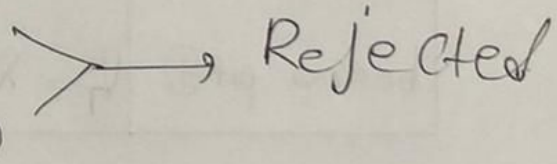
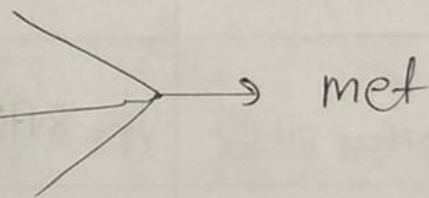
location (1)

location (2)

location (3)

location (4)

location (5)



Problem (5): - Given: $\gamma_{d \max} = 16.9 \text{ KN/m}^3$
 $\gamma_{d \min} = 14.2 \text{ KN/m}^3$
field Relative density, $D_r = 82\%$

$$(A) : D_r = \frac{\gamma_{d \max}}{\gamma_d} \left(\frac{\gamma_d - \gamma_{d \min}}{\gamma_{d \max} - \gamma_{d \min}} \right)$$

field dry density

$$\rightarrow 0.82 = \frac{16.9}{\gamma_d} \left(\frac{\gamma_d - 14.2}{16.9 - 14.2} \right)$$

$$0.131 \gamma_d = \gamma_d - 14.2$$

$$\gamma_d = 16.34 \text{ KN/m}^3$$

* Degree of compaction:

$$D_c = \frac{\gamma_d}{\gamma_{d \max}} \times 100\% = \frac{16.34}{16.9} \times 100\%$$
$$= 96.86\%$$

$$(B) \gamma_d = 16.34 \text{ KN/m}^3$$

$$(C) \gamma = \gamma_d (1 + w) = 16.34 (1.15)$$
$$= 18.791 \text{ KN/m}^3$$